Los Alamos
ICF and Radiation Physics

# ICF Monthly Highlights

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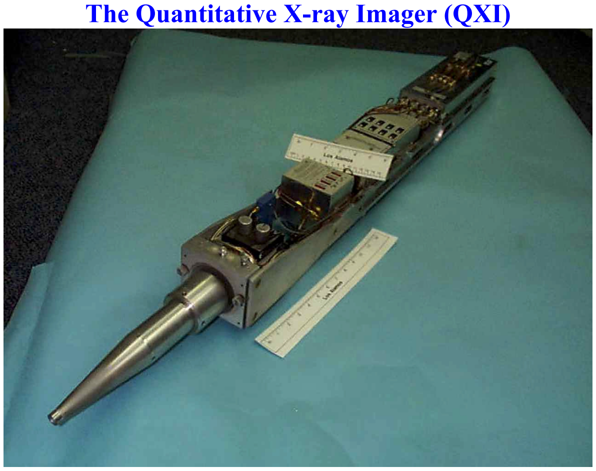
## The Quantitative X-ray Imager (QXI)



As part of its continuing development of time gated X-ray imaging capabilities for core NIF diagnostics, Los Alamos has developed a new gated X-ray camera, the Quantitative X-ray Imager (QXI). The QXI improves on the previous Gated X-ray Imager (GXI) in several areas which lead to the core NIF instrument. Gated image recording is done by sending a voltage pulse across a strip on a micro-channel plate. The QXI can be used either with 4 standard strips or 2 extra wide strips accommodating larger images. The pulse voltage is 4 keV, falling between the NIF camera's required 6 keV, and the GXI's 2 keV. As a result the QXI has ~20 times higher sensitivity than the GXI. Furthermore the gain and pulse length (down to 200ps) can be adjusted individually in each strip. The QXI's quantitative name derives from its reduced pulse jitter of <20ps and its special calibration - pulser checks and flat-fielding done after each experiment. Its images of imploded cores of single and double shell capsules (such as in Figure 2), instability growth in cylindrical implosions, and structured shock propagation have made it the workhorse Los Alamos imager, and takes us one step closer to quantitative, high resolution X-ray imaging on the NIF. The current model of the QXI has been utilized in experiments on the Trident and Omega laser systems.
*For more information contact Scott Evans (evans_s@lanl.gov)*

## Improved performance in Double Shell Capsule Implosions

The goal of the double shell implosion campaigns, beginning at the NOVA laser and currently in progress at the Omega laser at the University of Rochester, Laboratory for Laser Energetics, has been to assess the viability of a potential non-cryogenic ignition target for the National Ignition Facility. The earliest double shell experiments, at the Gekko XII laser in 1983 with an IR drive, gave yields well under 1% of that calculated. The concept fell from favor after that and lay dormant until several years ago when a new series was started at NOVA by Los Alamo. As in 1983, the NOVA targets produced poor results, with a yield compared to clean calculations (YOC) in the 0.5-2.5% range for a burn averaged convergence ratio of approximately 32. Since this CR is the same as one of the double shell designs for NIF, this result was not very encouraging. Because the implosions were done in a cylindrical hohlraum with relatively poor laser energy and power balance, the concept was taken to Omega for further tests. These used a tetrahedral hohlraum geometry which was expected to produce a much better thermal drive symmetry than the NOVA cylindrical hohlraum. Those initial implosions produced nearly identical results to the earlier NOVA data, suggesting that the thermal environment was perhaps not the main culprit in the failure of the implosions. Measurements of the hohlraum drive in the tetrahedral hohlraum indicated that about 7% of the entire radiation drive was actually in the Au M-band. This drive would be subject to much more non-uniformity than the thermal component, due to localization of the M-band at the laser spot. New double shell targets were designed to test whether the non-uniform M-band degrades performance in both double and single shell implosions. The intent of these designs was either to reduce the M-band incident on the most unstable surface in the implosion, the outer surface of the inner capsule, or to remove most of the material in the inner capsule capable of absorbing any M-band present. Either or both of these were expected to significantly improve performance if M-band nonuniformities were to blame for the implosion problems. The initial results from these targets were striking. The capsule designed to reduce absorption of the M-band resulted in a YOC of 40 and 60 % on two shots taken in March 1999. One of the targets intended to suppress the M-band incident on the inner capsule also came in with a YOC higher than the historical results by a factor of about 5, all at a convergence ratio of 32.

The campaign in October 1999 was designed to confirm the high YOC results for the reduced M-band absorption target, and investigate further the performance of the suppressed M-band target. The three target designs used in the March and October 1999 campaigns are shown in Figure 1. Observations of ICF implosions using capsules with two concentric shells separated by a low density region (double-shells) closely follow one dimensional (1D) radiatively driven hydrodynamics simulations. Both the suppressed M-band and the reduced M-band designs operated closer to 1D simulations than the standard target design. One capsule design achieved 50-100% of the unperturbed 1D yield at a convergence ratio of 27, identical to that of a double shell design for an ignition capsule at the National Ignition Facility. *This work has been submitted to Physics of Plasmas. For more information contact Bob Watt (rwatt@lanl.gov)*

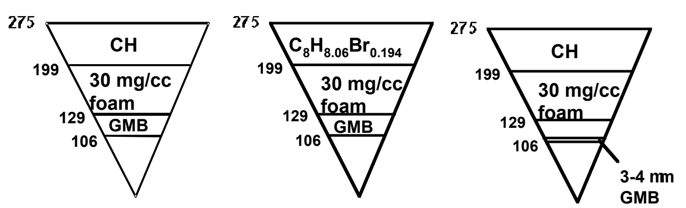



**Figure 1 Three target designs used in the March and October 1999 double shell campaigns. The reduced M-band absorption target used three different fill pressures in October 1999 to vary the convergence ratio.**

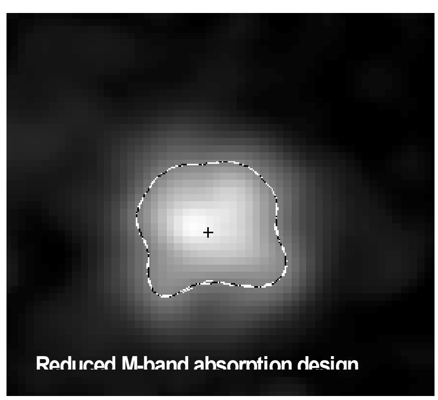



**Figure 2. Imploded core image from QXI at minimum radius. The FWHM is 32 μm, in virtually perfect agreement with post-processed 1D simulation results.**

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